

## Plasma Extraction of Oxygen from Martian Atmosphere, Phase I

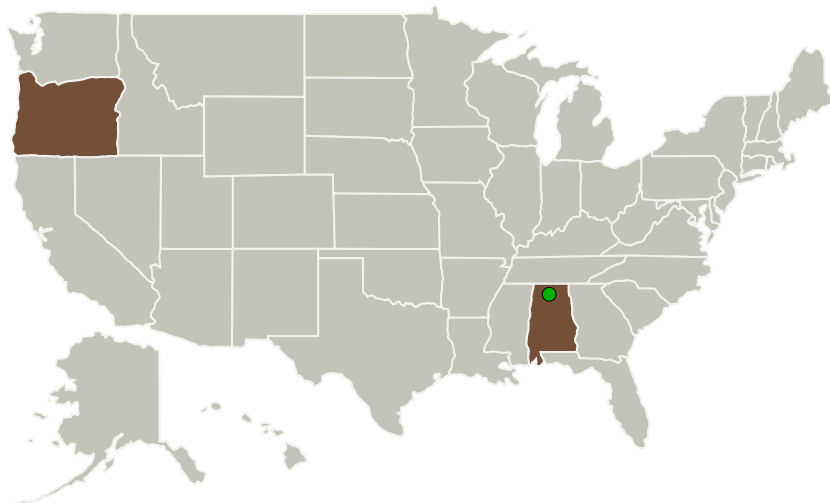
Completed Technology Project (2014 - 2014)




## Project Introduction

Plasma techniques are proposed for the extraction of oxygen from the abundant carbon dioxide contained in the Martian atmosphere (96 % CO<sub>2</sub>). In this process, CO<sub>2</sub> is directly decomposed in an energetic plasma forming O<sub>2</sub> and CO, which are immediately separated. The Phase I project will clearly demonstrate the feasibility of achieving these goals by focusing on key aspects of the technology, such as efficient microwave plasma conversion at relevant pressures and processing rates as well as effective techniques for O<sub>2</sub> separation from product gases. System mass and energy efficiency of this novel technology will be compared to those for SOA processes. The Phase II program will advance the technology through a more in depth development effort to the point where a fully functional prototype will be assembled and tested. Successful culmination of this effort will result in a self-contained, energy efficient technique that can be utilized by robotic precursor missions to Mars to stockpile oxygen in support of future manned missions to the planet.

## Primary U.S. Work Locations and Key Partners



| Organizations Performing Work   | Role                    | Type        | Location             |
|---|-------------------------|-------------|----------------------|
| UMPQUA Research Company   | Lead Organization       | Industry    | Myrtle Creek, Oregon |
|  Marshall Space Flight Center (MSFC) | Supporting Organization | NASA Center | Huntsville, Alabama  |

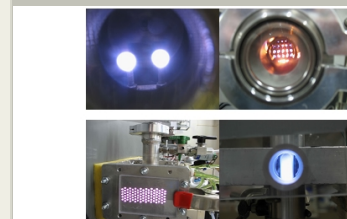


Figure 1. Examples of microwave plasma reactors fabricated by UMPQUA.

Plasma Extraction of Oxygen from Martian Atmosphere Project Image

## Table of Contents

|  |   |
|--|---|
| Project Introduction                         | 1 |
| Primary U.S. Work Locations and Key Partners | 1 |
| Project Transitions                          | 2 |
| Images                                       | 2 |
| Organizational Responsibility                | 2 |
| Project Management                           | 2 |
| Technology Maturity (TRL)                    | 2 |
| Technology Areas                             | 3 |
| Target Destinations                          | 3 |

## Plasma Extraction of Oxygen from Martian Atmosphere, Phase I

Completed Technology Project (2014 - 2014)



## Primary U.S. Work Locations

Alabama

Oregon

## Project Transitions

**June 2014:** Project Start**December 2014:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/137551>)

## Images

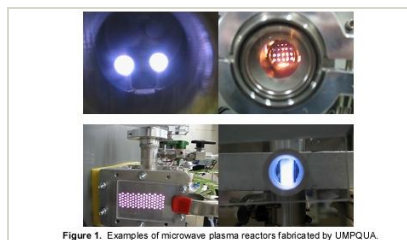


Figure 1. Examples of microwave plasma reactors fabricated by UMPQUA.

**Project Image**

Plasma Extraction of Oxygen from Martian Atmosphere Project Image  
(<https://techport.nasa.gov/image/132981>)

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

UMPQUA Research Company

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

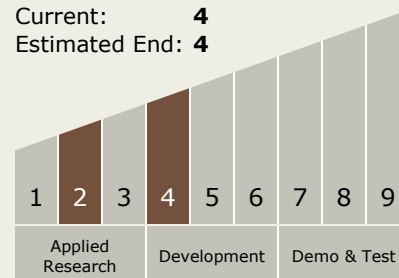
Carlos Torrez

**Principal Investigator:**

Richard Wheeler

## Technology Maturity (TRL)

Start: 2  
Current: 4  
Estimated End: 4



# Plasma Extraction of Oxygen from Martian Atmosphere, Phase I

Completed Technology Project (2014 - 2014)



## Technology Areas

### Primary:

- TX07 Exploration Destination Systems
  - └ TX07.1 In-Situ Resource Utilization
    - └ TX07.1.3 Resource Processing for Production of Mission Consumables

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System